Towards Autonomous Lunar Resource Excavation via Deep Reinforcement Learning

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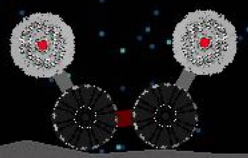
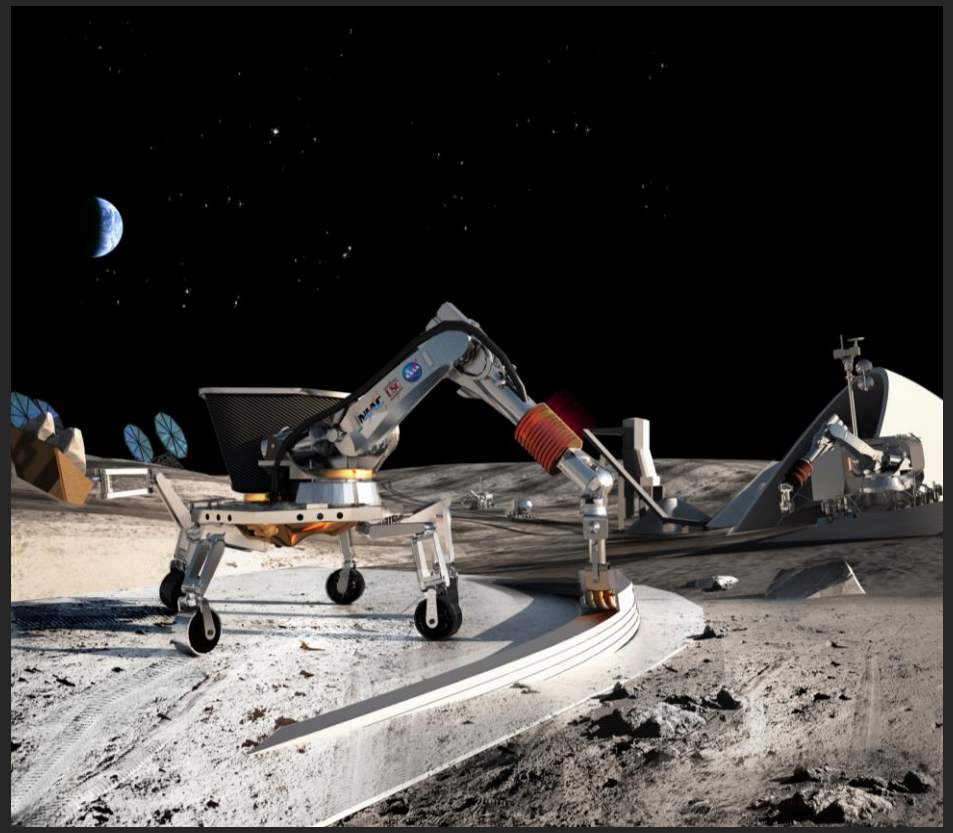
Presented on November 17, 2021

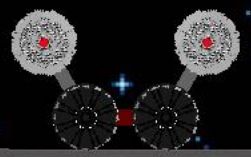
Session: TECH.SRU-10/IS-07, ISRU Applications of Intelligent Systems
AIAA ASCEND Conference 2021



Motivation

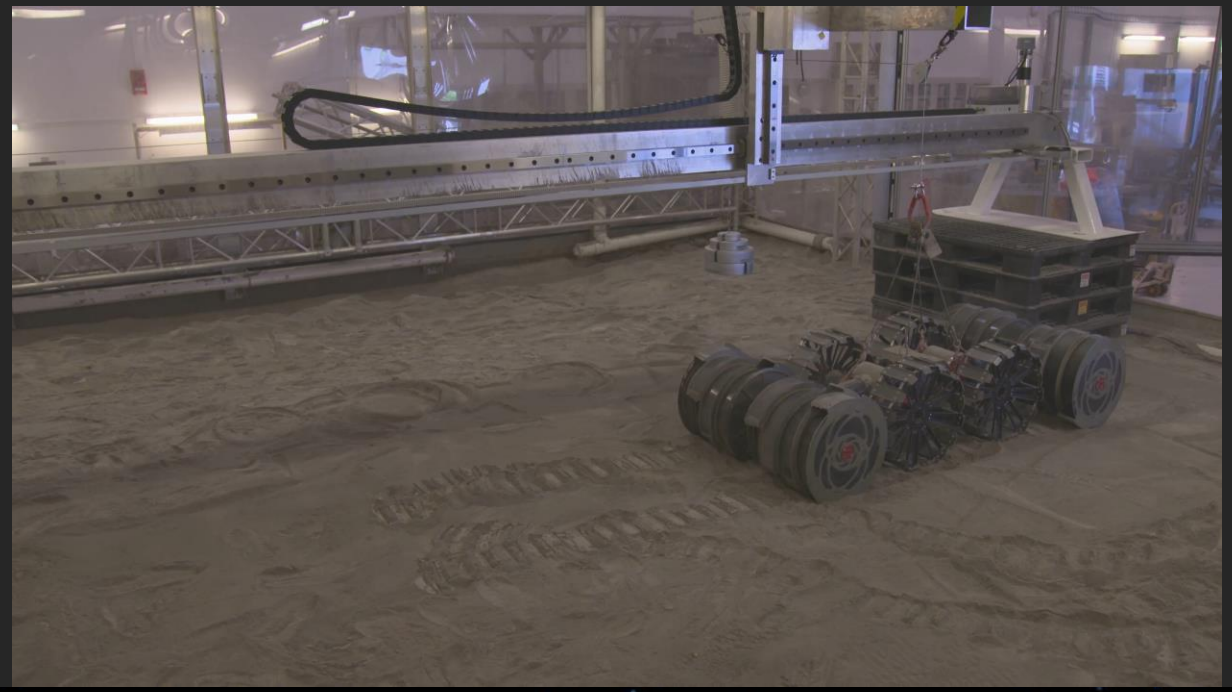
- Affordable and sustainable lunar presence, and beyond.
- In-Situ Resource Utilization (ISRU).
- Leverage resources for mineral value and construction.
- Need for excavation system to transport regolith.

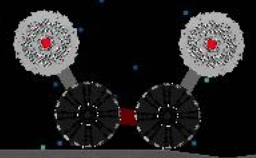




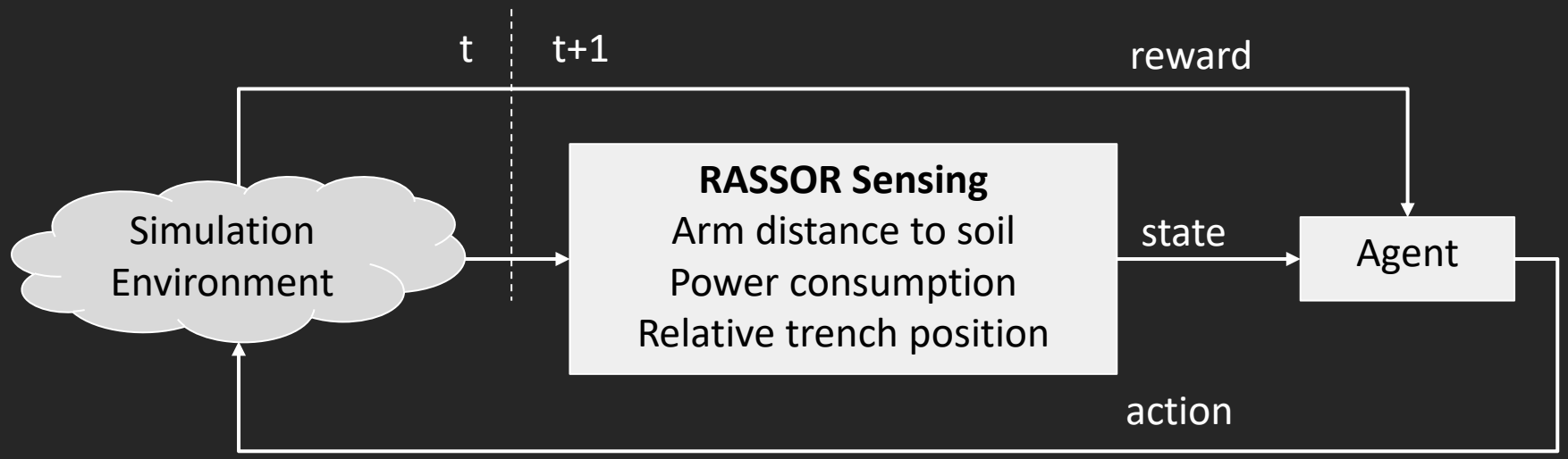
Motivation (continued)

- Regolith Advanced Surface Systems Operations Robot (RASSOR)
- Advanced autonomy methods: Intelligent Capabilities Enhanced RASSOR (ICE-RASSOR)

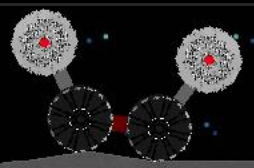




Reinforcement Learning

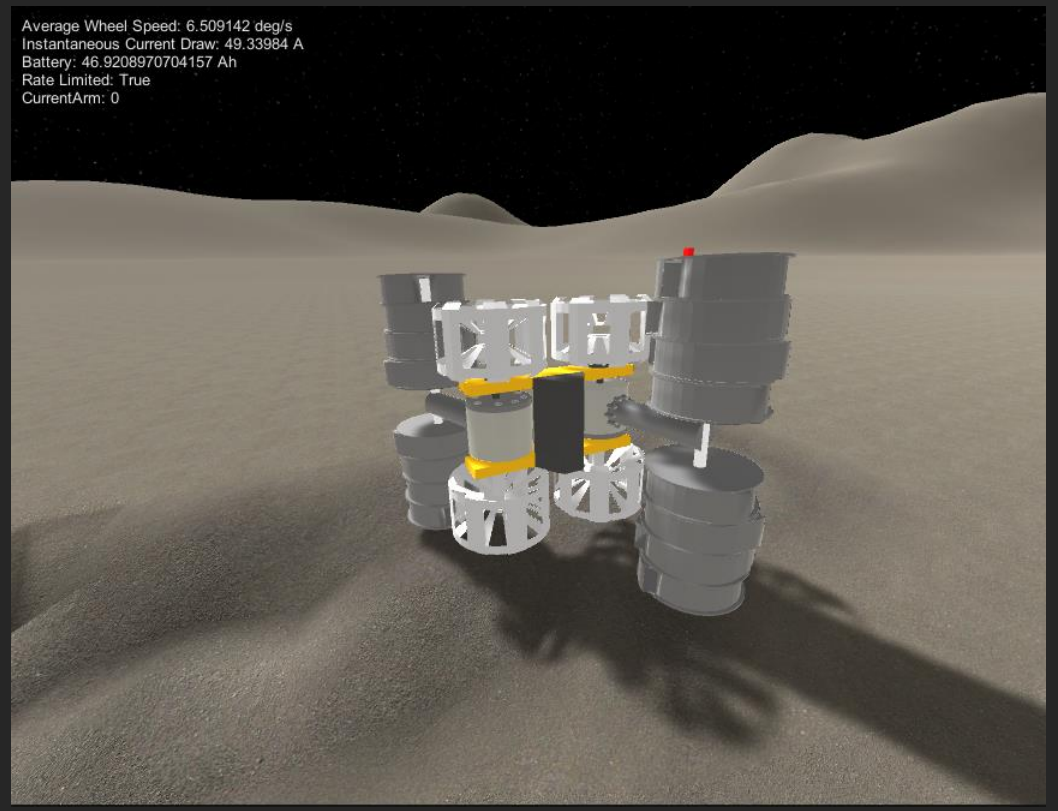


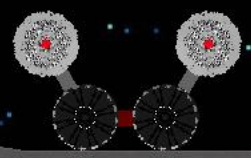
Learning within a 2D Simulation



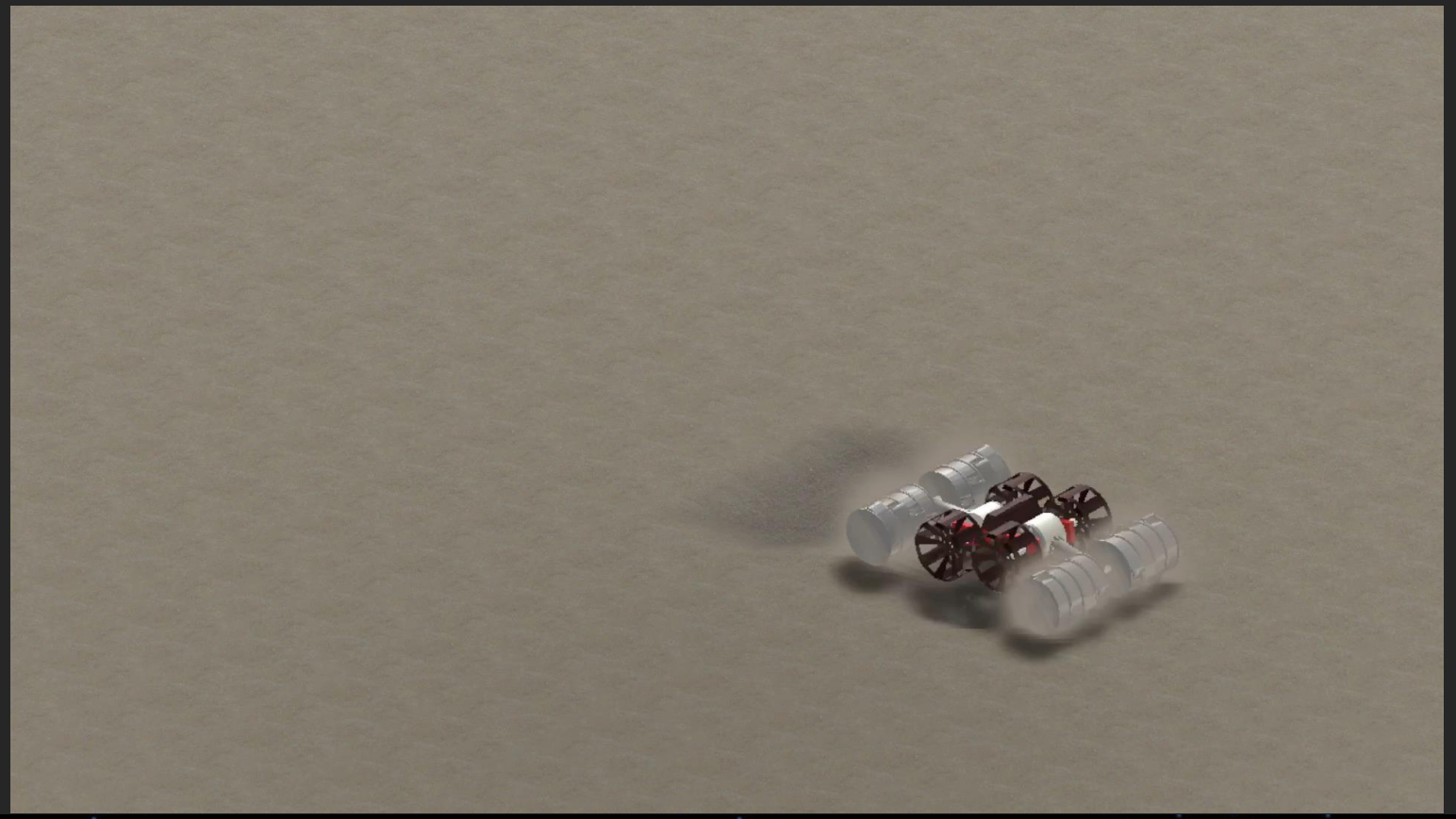
3D Simulation Development

- There is a need for 3D excavation simulations.
- We developed our own with Unity 3D Engine.
- Trade-off between fidelity and performance.
- Modeling the environment and excavation.

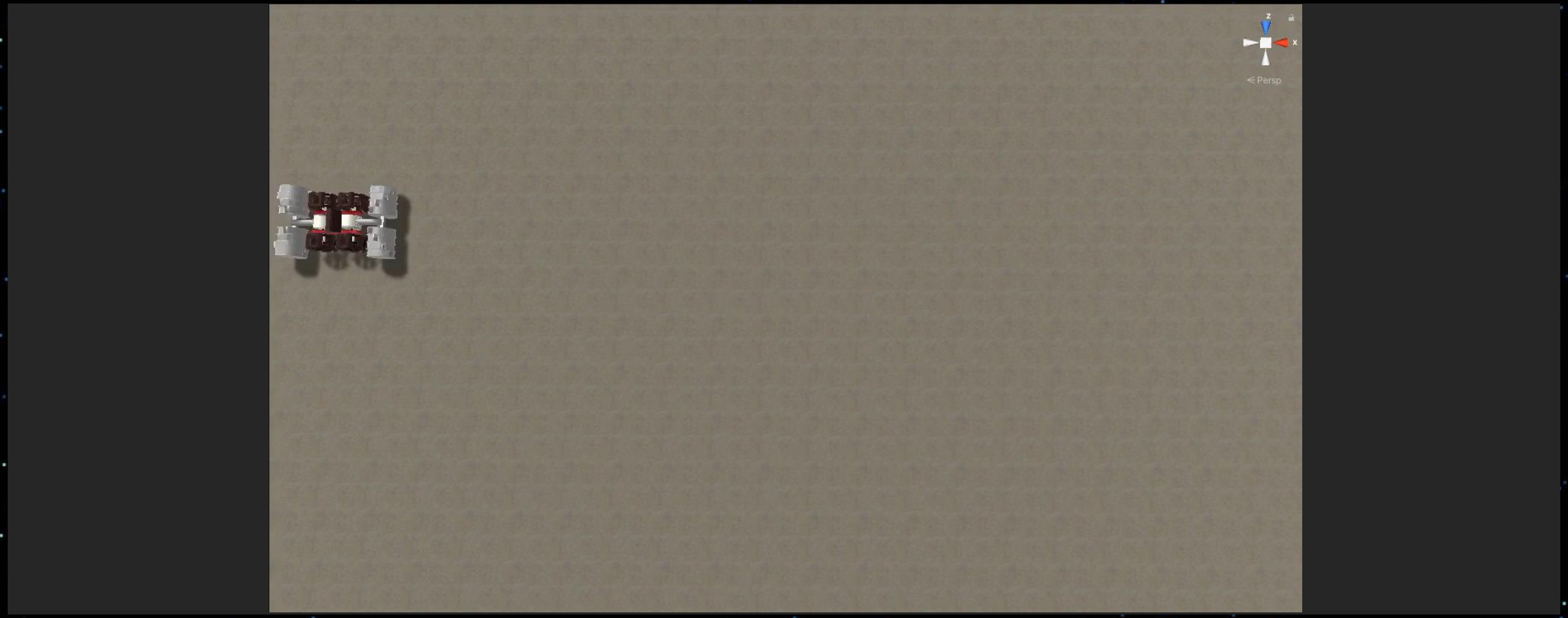




Learning within a 3D Simulation



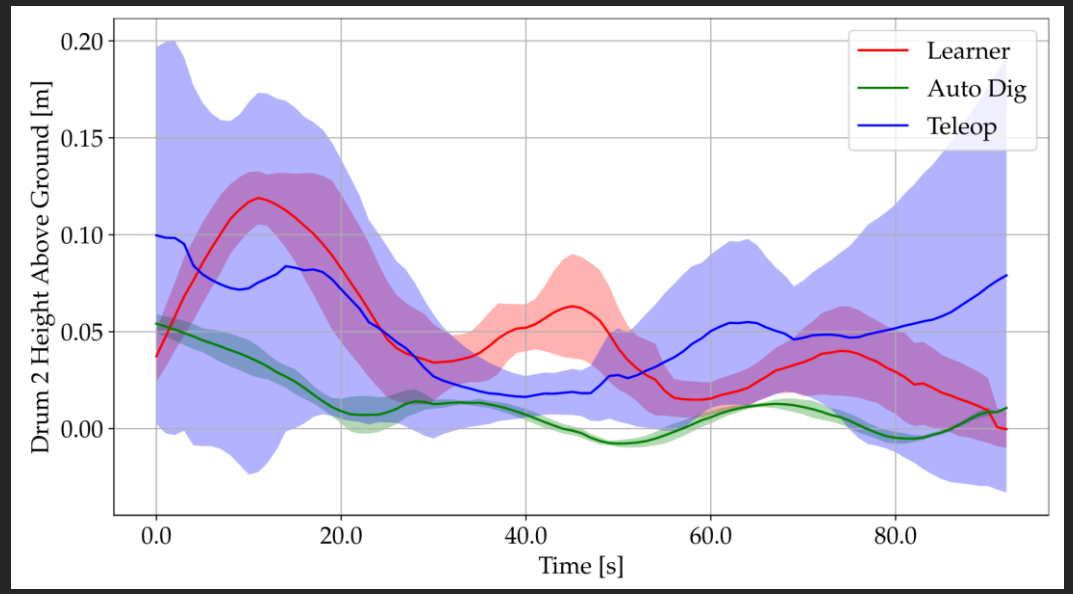
Learned Excavation Routine in 3D Simulation

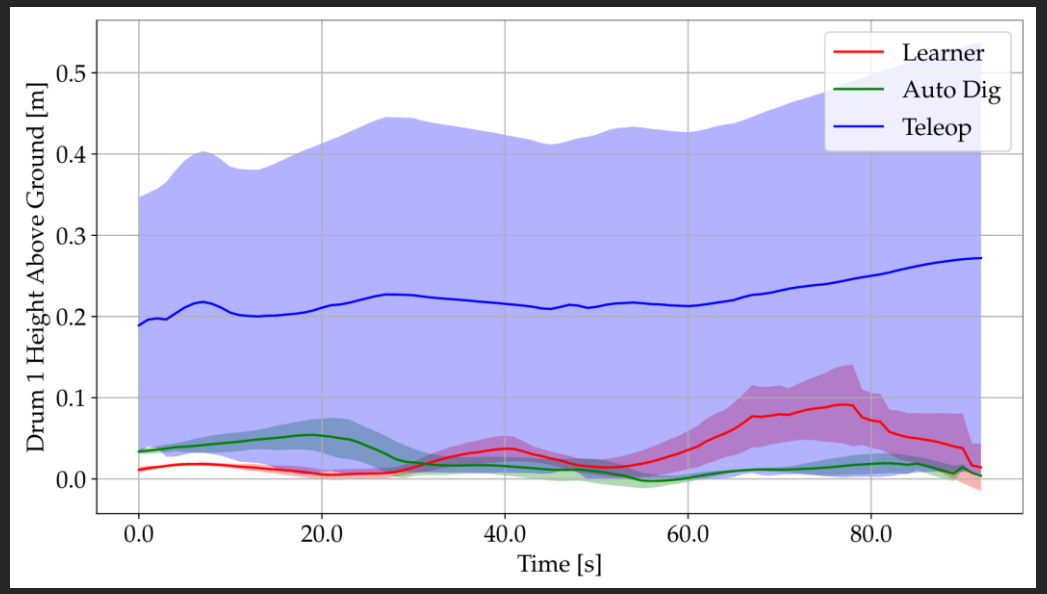


Learned Excavation Routine in 3D Simulation

Results of Learning in 3D Simulation

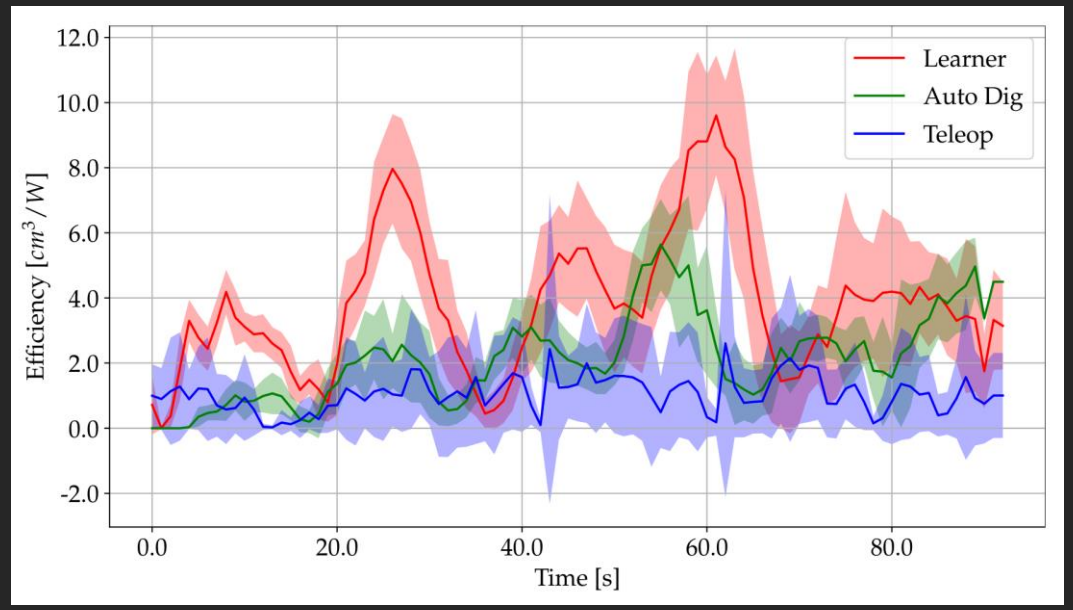
Soil height above ground

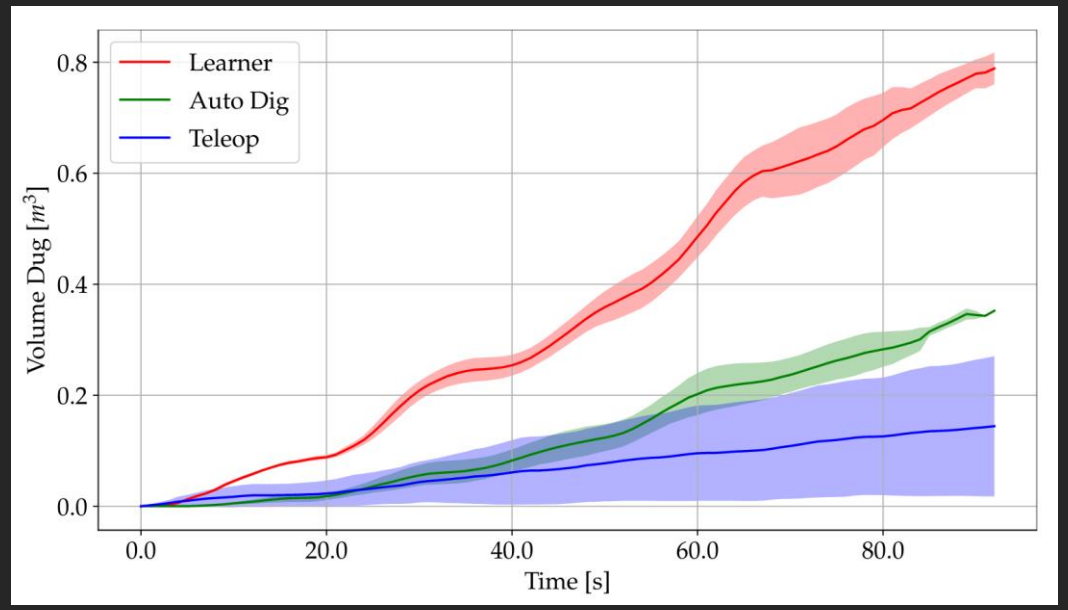




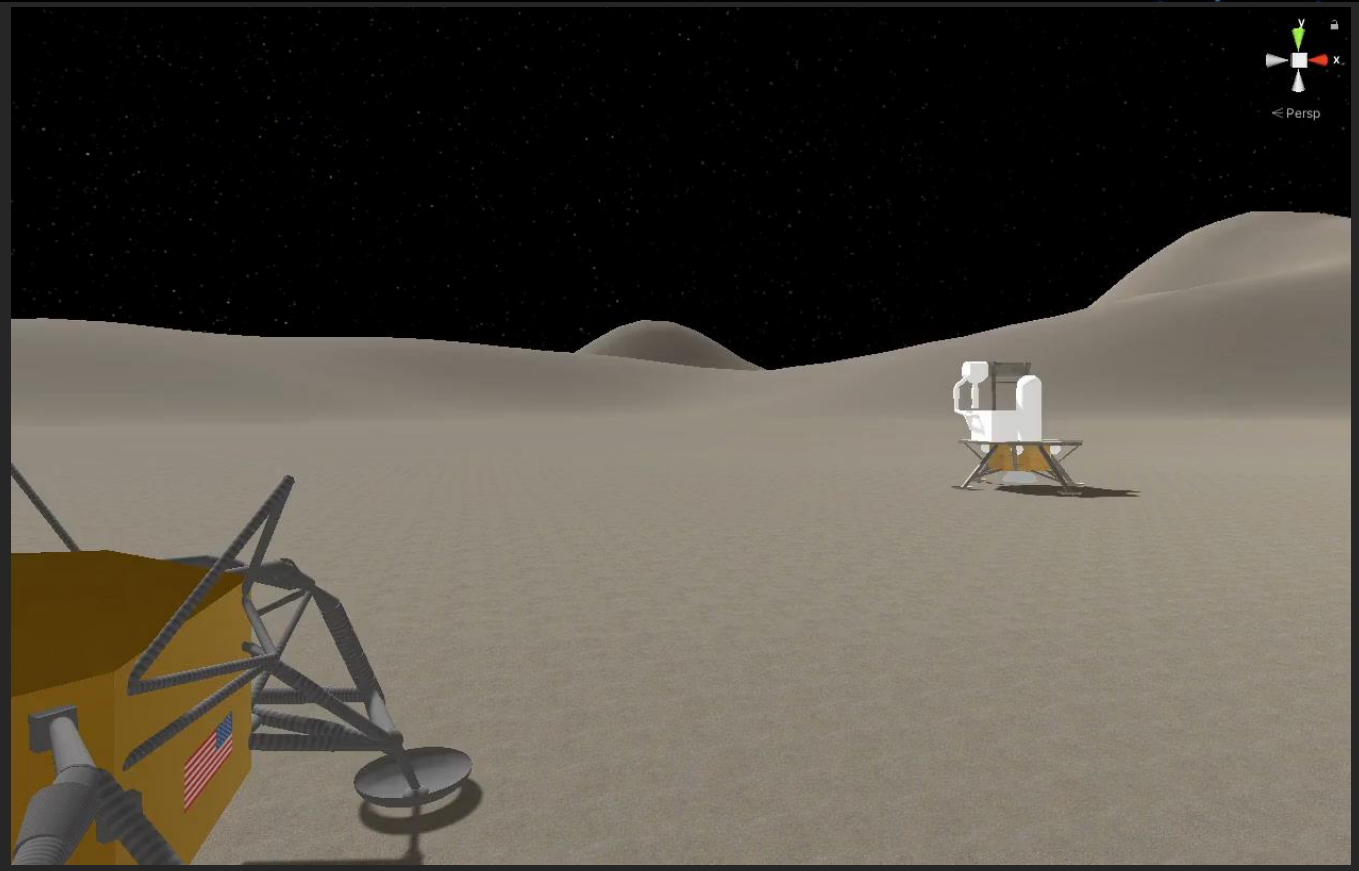
Results of Learning in 3D Simulation

Efficiency plots





Conclusion



Thank You.
Questions

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